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Method and device for the optical monitoring of a running fibre strand

The invention relates to a method for optically monitoring a running fibre strand according to the preamble of claim 1 and a device for carrying out the method according to the preamble of claim 8. A fibre strand in the context of the present invention is taken to mean a fibre band or a roving which are subsequently further processed to form a thread, or else the thread itself.

A generic method and a generic device are known, for example from EP 0 643 294 A1.

During further processing of fibre materials, it is known that the presented fibre material may contain impurities in the form of foreign substances and foreign fibres, which can lead to undesired irregularities in the thread produced therefrom and therefore also in the textiles produced in the subsequent processes. To avoid impurities of this type arriving in the thread or the textile, the fibre strand is optically monitored. A method and a device are known for this purpose from EP 0 643 294 A1, in which the fibre strand is acted upon by a light signal. The reflection signal generated by the fibre strand is guided to an image by means of a detector. The luminous intensity of the image is compared with a predetermined threshold value by means of evaluation electronics. The predetermined threshold value thus provides the limit value for a still acceptable impurity in the fibre strand. If this limit value is exceeded, a fault signal is generated in order to trigger a process intervention.

The known method and the known device are based on the fact that the foreign substances and foreign fibres are present with regard to their appearance in such a way that they have a clearly different reflection behaviour of light signals compared to the fibre to be produced. In the cases in which, for example, foreign fibres or foreign substances of the same colour are incorporated in the fibre strand, identification is not possible with the known methods and the known device.

The object of the invention is now to provide a method and device for monitoring a fibre strand made of natural fibres of the generic type, by means of which identification of foreign fibres which are of the same-colour or transparent in the fibre strand is also possible.

This object is achieved according to the invention by a method with the features according to claim 1 and with a device with the features according to claim 8.

Advantageous developments of the invention are defined by the features and feature combinations of the respective sub-claims.

The invention is based on the recognition that natural fibres, such as, for example cotton, in the microscopic structure consist of a cell composite. A fibre of this type is hardly in a position to guide a light signal because of the cell transitions. In comparison, synthetic substances or fibres have relatively good light conductivity, however. From this recognition, the invention provides that the light signal firstly impinges on the fibre strand in an input region, while the relayed light signal from the fibre strand is detected in

an output region located outside the input region. The output light signal therefore indicates foreign fibres, which have a light conductivity and can therefore guide the input light signal out of the input region into the output region. The input region defines the zone in which the light signal impinges on the fibre strand. The output region denotes the zone, in which the relayed light signal is detected by a sensor, when it is output. For this purpose, the light source is directed onto the input region and the detector onto the output region.

The invention is therefore particularly suitable for identifying, in particular, foreign fibres made of synthetic material, such as polypropylene, which are generally used in practice as packaging material for the unspun natural fibre and can thus arrive, during unpacking, as a foreign component in the further processing of the natural fibres, in the spinning process.

As synthetic fibres have a smooth surface, these are not incorporated into the natural fibre composite like a natural fibre. Because of the lack of adhesion, a large number of kink positions occur along the only partially incorporated foreign fibre made of synthetic material, which lead to the input and output of the light signals. The input region and the output region can therefore be separated from one another. The regions can be arranged next to one another on the fibre strand at a spacing in the millimetre range and/or be offset with respect to one another at an angle which substantially also prevents touching or even overlapping of the regions. In this matter, very short fibre pieces can also be reliably identified. It is avoided by means of a minimum spacing

between the input region and the output region, that reflection signals from the input region are also detected, which would influence the measuring result and therefore the reliable detection of foreign fibres. A spacing in the range of 0.5 mm to 5 mm has proven successful.

In order to obtain as high a luminous intensity as possible in the input region, the light signal is projected perpendicularly as a very narrow band onto the fibre strand. In this case, the light signal is preferably generated by a laser. The light band preferably has a width here of about 2 mm.

In order to easily determine the presence of a foreign substance, according to an advantageous development of the invention, the output light signal is received by a photocell. The luminous intensity of the output light signal is decisive here for determining the foreign fibres or foreign substance.

In order to detect, in this case, as narrowly limited a region as possible on the fibre strand, the photocell can be combined with an optical system, advantageously with a macrolens, by which the output region is defined on the fibre strand.

For reliable recognition of a foreign substance and in order to avoid the foreign substance arriving in the fibre end product, the luminous intensity measured is compared with a threshold value. Only when the threshold value is exceeded is a fault signal generated, which in turn triggers a process intervention, in particular a process interruption with subsequent elimination of the section of the fibre strand containing foreign fibres. For this purpose, the device

according to the invention has evaluation electronics with a storage means and a computer means. The evaluation electronics can therefore be directly combined with a control mechanism, by means of which the production process is controlled.

The method according to the invention will be described in more detail hereinafter with the aid of an embodiment of the device according to the invention with reference to the accompanying figures.

In the drawings:

Fig. 1 schematically shows a first embodiment of the device according to the invention for carrying out the method according to the invention,

Fig. 2 schematically shows a plan view of a fibre strand to be monitored,

Fig. 3 schematically shows a further embodiment of the device according to the invention for carrying out the method according to the invention.

Fig. 1 schematically shows a first embodiment of the device according to the invention for carrying out the method according to the invention for optical monitoring of a fibre strand, by way of example, in the form of a fibre band. This fibre strand may alternatively be a thread.

The device has a light source 2, which is configured as a laser and which generates a bundled light signal 3 perpendicularly to the running fibre strand 1. The light

signal 3 impinges on the surface of the fibre strand 1 in an input region 4.

An output region 6 is associated with the input region 4 at a spacing A in the running direction of the fibre strand 1. The output region 6 represents the zone on the fibre strand 1, onto which a detector 9 and an optical system 8 are directed for monitoring the fibre strand. The detector 9 is configured as a photocell, which is coupled to evaluation electronics 10. The evaluation electronics 10 contain a storage means 11 and computer means 12. The evaluation electronics 10 are connected to a control mechanism 13.

To describe the method according to the invention, reference is made below, in addition to Fig. 1, also to Fig. 2. Fig. 2 shows schematically here a plan view of the fibre strand 1 with a light signal which is projected onto the surface of the fibre strand 1 and shows, in the form of a light band 14, the input region 4. At a spacing next to the input region 4, the output region 6 adjusted by the optical system 8 is identified as a circle.

To monitor the running fibre strand 1, consisting of natural fibres, in a first position, a light signal 3 generated by a light source 2 is projected onto the surface of the fibre strand 1. This position is denoted an input region 4, in which the light signal 3 is input into the fibre composite of the fibre strand 1. If the fibre strand 1 contains a foreign fibre 5 made of synthetic material, a light quantity also arrives from the light signal 3 into the foreign fibre 5. The light is preferably input at kink positions or edges of the foreign fibre and relayed by the foreign fibre. The light inside the

foreign fibre 5 thus arrives at the output region 6 arranged at a spacing A. Perpendicularly to the fibre strand 1, the output region 6 is scanned by the optical system 8 and the detector 9. The optical system 8 is preferably formed by a macrolens in order to obtain as small as possible an observation region covering the fibre strand with respect to its thickness. The size of the output region depends in this case on the thickness of the fibre strand. Owing to the kink positions contained in the foreign fibre 5, light waves are output, which arrive at the detector 9 from the output region 6. The detector 9 is configured as a photocell in order to receive and evaluate the output light signals. The spacing A between the input region 4 and the output region 6 is about 1 mm. This is the distance over which the light has to be guided. The spacing may, depending on the circumstance and the size of the foreign fibres to be detected, may be 0.5mm to 5 mm or more.

To evaluate the light signals detected by the photocell, the detector 9 is linked to the evaluation electronics 10. The threshold value is filed in the storage means 11 of the evaluation electronics 10. The threshold value is, in this case, an acceptable luminous intensity, which is used as a limit value to identify a foreign substance. The measured signal emitted by the detector and the threshold value are compared with one another in the computer means 12, which may be formed, for example, by a comparator. When the threshold value is exceeded, a fault signal is generated, which is relayed by the evaluation electronics directly to the control mechanism 13. Inside the control mechanism 13, the fault signal leads to the triggering of a process change, in particular an interruption of the fibre strand with a

subsequent elimination of the fault position. It is thus ensured that the fibre section with the foreign fibre does not reach the end product.

In the embodiment shown in Fig. 1, the light source and the detector are arranged in one plane with the longitudinal axis of the fibre strand and, for example, combined in one unit. Because of the generally non-uniform and irregular course of the foreign fibre, the input and output of the light signals is ensured. To improve the input or output effect, however, the light source and the detector may be arranged at an angle differing from 90° with respect to the running direction of the fibre strand. Furthermore, the use of a laser as a light source and a photocell as a detector in the embodiment according to Fig. 1 is by way of an example. Basically, other light-emitting optical systems can be used, which have a divergence towards zero in order to project light signals onto the surface of the fibre strand. Line sensors can also advantageously be used as detectors.

A further embodiment of the device according to the invention for carrying out the method according to the invention is shown schematically in Fig. 3. A schematic view transverse to the fibre running direction is shown here. The fibre strand 1 is shown here in a cross-sectional view, which is the same as the drawing plane. To generate a light signal 3, a light-emitting diode is provided here, for example. In order, as far as possible, to generate a light band with a high intensity on the surface of the fibre strand 1, an optical system 15, consisting of a lens and a shutter, is present. In this case, the light signals 3 impinge on the fibre strand 1 in the input region 4.

The optical axis of the output region 6 is, however, offset by an angle with respect to the optical axis of the input region 3. An optical system 8, for example in the form of a macrolens, and a detector 9, for example in the form of a photocell, are associated with the output region 6.

The functioning of the device shown in Fig. 3 is identical to the preceding embodiment, so reference is made to the preceding description at this point. In the embodiment shown in Fig. 3, a smaller spacing may also be present, in addition, between the input region and the output region in the longitudinal direction of the fibre strand. The angular offset between the optical axes allows a very compact mode of construction.

The method according to the invention and the device according to the invention have the particular advantage, that, especially in the processing of natural fibres, the foreign fibre components released from the packaging material can be reliably identified and eliminated, even when they are transparent or do not differ with regard to their colour from the natural fibres. Interwoven fabrics made of film tapes, preferably made of polypropylene, are used as packaging. Owing to the light conductivity of the PP fibre, identification with a high degree of certainty is possible in the monitoring of the fibre strand. In principle, every light spot which is visible within the output region can be identified as a foreign substance.